SHAFT ASSEMBLY SAFETY MECHANISM

BACKGROUND

[0001] The present invention relates to shaft components. More particularly, the present invention relates to a safety mechanism for reducing the likelihood of an improper shaft assembly.

[0002] Shafts are utilized in many applications and generally require interconnection between the shaft and a secondary component. The secondary component can be an independent component or secondary shafts such that the shaft serves as an intermediate shaft. In both instances, the forward end 22 of the shaft 20 is interconnected with a coupling element 10 which in turn is interconnected with the secondary component (not shown).

[0003] Many different coupling elements can be utilized with the present invention, with an exemplary coupling element 10 illustrated in Fig. 1. The coupling element 10 has a shaft receiving and retaining slot 12 and a retaining bolt 16 that is passed through and secured in a through bore 14 in the coupling element 10. Typically, the shaft 20 has a notch, annular groove or other form of bolt receiving recess 24 adjacent the forward end 22 of the shaft 20. The forward end 22 of the shaft 20 is first positioned in the slot 12 (as indicated by the arrow 1 in Fig. 1) with the bolt receiving recess 24 aligned with the through bore 14. Thereafter, the retaining bolt 16 is slid through the through bore 14 and bolt receiving recess 24 (as indicated by the arrow 2 in Fig. 1) and secured by a cotter pin, nut or the like. The retaining bolt 16 extending through the bolt receiving recess 24 permanently secures the shaft 20 to the coupling element 10.

[0004] In many applications, for example, a steering intermediate shaft, the interconnection of the shaft 20 and coupling element 10 occurs in a location with limited accessibility. As such, it is difficult to visually or manually check that the retaining bolt 16 is properly received in the bolt receiving recess 24. For example, as illustrated in Fig. 2, the shaft 20 may not be fully inserted into the coupling element slot 12 when the retaining bolt 16 is inserted. As a result, the retaining bolt 16 is not received in the bolt receiving recess 24. In some instances, the forward end 22 of the shaft 20 jams between the inserted retaining bolt 16 and the inner surface 18 of the coupling element slot 12. If the shaft 20 is jammed sufficiently, it may give a rigid feeling to an assembly worker, thereby creating a false sense that the shaft 20 is properly interconnected. After some use, the shaft end 22 may dislodge from between the retaining bolt 16 and slot surface 18, thereby causing disassembly and failure of the coupling.

SUMMARY

[0005] The present invention provides a shaft coupling assembly. The assembly comprises a coupling element including a shaft-receiving slot configured to receive a shaft. A retaining bolt is extendable through the coupling element adjacent the shaft receiving slot. The shaft includes an axial shaft body having upper and lower surfaces and terminating in a forward end configured to be inserted into the coupling element slot. A bolt receiving recess in the upper shaft surface adjacent the forward shaft end is configured to receive and retain the retaining bolt after the shaft forward end is inserted into the coupling element slot. At least one projection extends from the shaft forward end adjacent the shaft upper surface whereby, in the event the retaining bolt is extended through the

coupling element prior to proper insertion of the shaft forward end into the coupling element slot, the projection contacts the retaining bolt and prevents improper clamping of the shaft forward end and any associated feeling of proper interconnection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Fig. 1 is an isometric view of a prior art shaft positioned for engagement with an exemplary coupling element.

[0007] Fig. 2 is a side elevation view, with the coupling element shown in cross section, of a prior art shaft improperly interconnected with the coupling element.

[0008] Fig. 3 is a side elevation view of a shaft of a first embodiment of the present invention positioned for engagement with an exemplary coupling element.

[0009] Fig. 4 is a top elevation view of the shaft of Fig. 3 positioned for engagement with an exemplary coupling element.

[0010] Figs. 5-7 are side elevation views, with the coupling element shown in cross section, of the shaft of Fig. 3 improperly inserted into the coupling element.

[0011] Fig. 8 is a side elevation view of a shaft of a second embodiment of the present invention positioned for engagement with an exemplary coupling element.

[0012] Fig. 9 is a top elevation view of the shaft of Fig. 8 positioned for engagement with an exemplary coupling element.

[0013] Fig. 10 is a side elevation view, with the coupling element shown in cross section, of the shaft of Fig. 8 initially improperly inserted into the coupling element.

[0014] Fig. 11 is a side elevation view similar to Fig. 10, illustrating the improperly inserted shaft automatically withdrawing from the coupling element.

[0015] Figs. 12-13 are side elevation views, with the coupling element shown in cross section, of the shaft of Fig. 8 improperly inserted into the coupling element.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The present invention will be described with reference to the accompanying drawing figures wherein like numbers represent like elements throughout. Certain terminology, for example, "right", "left", "front", "frontward", "forward", "back", "rear" and "rearward", is used in the following description for relative descriptive clarity only and is not intended to be limiting.

[0017] Referring to Figs. 3-5, a shaft 30 of the first embodiment of the present invention is shown. The shaft 30 has an axial body extending between a forward end 32 and a rear end (not shown). The shaft 30 includes a bolt receiving recess 34 adjacent the forward end 32 of the shaft 30. The bolt receiving recess 34 is similar to the bolt receiving recess 24 of the prior art shaft 20 and is configured and positioned to receive the retaining bolt 16. The shaft 30 generally terminates in a blunt end 36 forward the bolt receiving recess 34. The shaft 30 has a generally complete cross-sectional area at the bolt receiving recess 34 such that a secure engagement occurs between the retaining bolt 16 and bolt receiving recess 34. A projection 40 extends from the generally blunt end 36 adjacent the top surface of the shaft 30. The projection 40 preferably terminates in a tapered tip 42.

[0018] Referring to Figs. 5-7, the projection 40 extending from the shaft 30 prevents a false sense of proper interconnection between the shaft 30 and the coupling element 10 that may be experienced with the prior art shaft 20. As illustrated in Fig. 5, if the retaining bolt 16 is inserted prior to insertion and proper positioning of the shaft 30, the tapered tip

42 of the projection 40 first contacts the retaining bolt 16, thereby causing the shaft 30 to tilt out of the proper axial alignment. Tilting of the shaft 30 provides an assembly worker with a visual indication that something, most likely an improperly inserted retaining bolt 16, is preventing proper insertion of the shaft 30 into the coupling element 10. Referring to Figs. 6 and 7, if the shaft 30 is only partially inserted, the projection tip 40 will help prevent a false sense of proper interconnection. As shown in Fig. 6, the projection 40 may block the through bore 14, thereby preventing insertion of the bolt 16 until the shaft 30 is properly inserted. Referring to Fig. 7, the projection 40 is preferably a length at least equal to the distance from the through bore 14 to the entry of the slot 12. As such, the full cross-sectional area of the shaft 30 is not received into the slot 12 until at least a portion of the projection 40 is blocking the through bore 14. Due to the reduce cross-sectional area, it is not possible for the coupling element 10 to clamp onto the forward end of the shaft 30.

[0019] Referring to Figs. 8-13, a shaft 50 of the second embodiment of the present invention is shown. The shaft 50 has an axial body extending between a forward end 52 and a rear end (not shown). The shaft 50 includes a bolt receiving recess 54 adjacent the forward end 52 of the shaft 50. The bolt receiving recess 54 is similar to the bolt receiving recess 24 of the prior art shaft 20 and is configured and positioned to receive the retaining bolt 16. The shaft 50 generally terminates at end surface 56 forward the bolt receiving recess 54. Again, the shaft 50 has a generally full area at the bolt receiving recess 54 such that a secure engagement occurs between the retaining bolt 16 and bolt receiving recess 54. A top projection 60 extends from the end surface 56 adjacent the top surface of the shaft 50 and a bottom projection 70 extends from the end surface 56 adjacent the bottom surface of the shaft 50 with an open space 80 defined therebetween. Each projection 60, 70

terminates in a tapered tip 62, 72, respectively. Referring to Figs. 8 and 9, each projection 60, 70 preferably narrows moving forward from the end surface 56 in both the vertical direction (Fig. 6) and the horizontal direction (Fig. 7). As such, each projection 60, 70 has a slight flexibility.

[0020] Referring to Figs. 10-13, the projections 60 and 70 extending from the shaft 50 prevent the false sense of proper interconnection between the shaft 50 and the coupling element 10 and further automatically withdraw a shaft 50 that is improperly inserted after insertion of the retaining bolt 16. As illustrated in Figs. 10 and 11, if the retaining bolt 16 is inserted prior to insertion and proper positioning of the shaft 50, the tapered tip 62 of the projection 60 first contacts the retaining bolt 16, thereby causing the projections 60 and 70 to compress between the retaining bolt 16 and the slot inner surface 18 with projection 60 flexing inward toward the open area 80 as indicated by arrow A in Fig. 10. Compression of the projections and thereby flexing of projection 60 creates an axial spring force in the direction of arrow B in Fig. 11. The created spring force causes the improperly assembled shaft to "pop" from the coupling element slot. The withdrawing shaft 50 again provides an assembly worker with a visual indication that something, most likely an improperly inserted retaining bolt 16, is preventing proper insertion of the shaft 50 into the coupling element 10 and prevents any false sense of proper interconnection.

[0021] Referring to Figs. 12 and 13, if the shaft 50 is only partially inserted, the projection tips 60 and 70 will help prevent a false sense of proper interconnection. As shown in Fig. 12, the top projection 60 may block the through bore 14, thereby preventing insertion of the bolt 16 until the shaft 50 is properly inserted. Referring to Fig. 13, the open space 80 between the projections 60 and 70 extends a length at least equal to the

distance from the through bore 14 to the entry of the slot 12. As such, the full cross-sectional area of the shaft 50 is not received into the slot 12 until at least a portion of the top projection 60 is blocking the through bore 14. Due to the reduce cross-sectional area, it is not possible for the coupling element 10 to clamp onto the forward end of the shaft 50.

[0022] It will be appreciated by those skilled in the art that changes can be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed.

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